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NOTES ON SOME POLEMONIACEOUS RUSTS[1]

C. R. Orton

Of the many problems encountered in taxonomic work with any group of plants that of nomenclature is sure to require a considerable amount of time and often more patience than the worker possesses. There are always some names in question whose identity is not certain because of discrepancies, either with regard to the labelling of type specimens or in connection with the published descriptions. The situation becomes more acute for the taxonomist working with parasitic organisms. Here the chance of error is practically doubled for both parasite and host are concerned.

A good example of such a situation has been encountered in the study of several rusts on polemoniaceous hosts. Several students of the rusts have been puzzled with this particular tangle and some valuable information has come to light. Holway[2] published some notes bearing on these species several years ago but since then few, if any, descriptive notes have appeared. During the preparation of the manuscript on the genus *Allodus* the writer[3] was compelled to reinvestigate this entire group of rusts with the result that some interesting facts have been disclosed which are thought to be of sufficient importance to record for the benefit of subsequent workers.

One of the earlier difficulties in connection with this group of rusts was due to the inaccessibility and consequent uncertainty regarding type specimens. During the summer of 1918, through the efforts of Dr. J. C. Arthur, Prof. H. S. Jackson, and other members of the botanical staff of the Purdue Agricultural Experiment Station, I was enabled to complete the examination of the types or portions of types of nearly every species here discussed and some of the uncertainties existing heretofore appear to be cleared up as thoroughly as it is possible to do so until cultures are made to verify their life histories.

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[1] Joint contribution from the Department of Botany, Indiana Agricultural Experiment Station, and the Department of Botany, The Pennsylvania State College, No. 16.

[2] Holway, E. W. D. Notes on Uredineae, IV. Jour. Myc. **11**: 268. 1905.

[3] Orton, C. R. North American Species of Allodus. Mem. N. Y. Bot. Garden **6**: 198–200. 1916.

Most of the uncertainties regarding the phlox rusts have centered around the well known species *Puccinia plumbaria* Peck, which is a rather common rust throughout the Rocky Mountain region on *Microsteris* and *Phlox*. Inasmuch as most of the confusion has been due to uncertainties and errors in host determinations considerable time has been given to the identification of the hosts, particularly the hosts of the type specimens. These have been submitted to various experts on this family such as Dr. P. A. Rydberg, Mr. P. C. Standley, and others to whom I extend thanks for their interest and the time they have taken from their many duties to make these studies.

For convenience in discussion, I have divided these rusts into three groups as follows: (1) *Allodus Giliae,* (2) *Allodus Douglasii* and (3) *Other outstanding species.*

1. ALLODUS GILIAE (Peck) Orton

Aecidium Giliae Peck, Bot. Gaz. 4: 230. 1879

This species was founded on a collection by M. E. Jones from Alta, Wasatch Mts., Utah, in August at an elevation of 8,000 ft. on leaves of *Gilia Nuttallii.* A portion of the type collection in the Peck herbarium was very kindly loaned by Dr. H. D. House and was found to bear aecia only. The host is undoubtedly named correctly and has been verified by Mr. Standley.

Another collection in the Peck herbarium was made by Jones at Alta, 10,000 ft. elevation, on the same host and bears only telia which appear in every way identical with *Puccinia plumbaria.*

Puccinia plumbaria Peck, Bot. Gaz. 6: 228. 1881

Peck described this conspicuous rust on the living leaves and stems of *Collomia gracilis* and *Phlox longifolia* from material collected by M. E. Jones in Utah and his description says in "June and August." The most striking gross character of this rust is the plumbeous appearance of the telia which are found on the leaves and stems. When the telia rupture, powdery, chocolate colored spores appear which upon microscopic examination are found to be finely but conspicuously verrucose. This surface marking of the teliospores is most pronounced upon the host genera *Microsteris* (*Collomia*) and *Phlox* and less evident upon the host genera *Leptodactylon* and *Linanthus*, although on the latter genera the verrucose markings are easily seen when the spores are examined dry under the higher objectives of the microscope. Teliospores from the type material measure 19–25 by 31–40 μ with the apex 5–7 μ thick and the pedicel fragile, colorless and fugaceous.

Both hosts mentioned by Peck in the original description are correct, but there is a discrepancy in the dates. The type material on *Microsteris* (*Collomia*) in the Peck collection bears the date May 5, 1880, and the "co-type" on *Phlox* bears the date June 6, 1880. There is no collection by Jones on *Collomia* in the Peck herbarium bearing the August date. We must therefore conclude that the dates in the original description should have been May and June.

Puccinia Wilcoxiana Thüm. Myc. Univ. *2032*. 1881

The original description of this rust is in Latin printed upon the exsiccatum label. The type was stated to be on some undetermined species of *Gilia* collected at Boise City, Idaho Territory, April, 1881, by J. E. Wilcox.

A small portion of the type material has been examined and appears identical with *Puccinia plumbaria* as that fungus appears on *Microsteris*. While the host material is rather scanty it has been possible to determine the host as *Microsteris humilis* Greene an annual plant clearly distinct from *Gilia Nuttallii* A. Gray which is perennial.

The question of priority of name arises with respect to this and the preceding species. In the New York Botanical Garden Herbarium there is a letter from Dr. W. G. Farlow to Mr. J. B. Ellis with regard to this matter. Dr. Farlow is of the opinion that Century XXI of Thümen's Mycotheca Universalis was not issued until after June and that Peck's name has precedence.

Another bit of substantiating evidence is the date of collection, April, 1881. It would hardly be possible for specimens collected in Idaho on this date to be sent to Europe and issued in an exsiccatum before June, the time of publication of *Puccinia plumbaria.*

Puccinia plumbaria phlogina Ellis. N. Am. Fungi *1044.* 1883

Ellis issued a collection under this name in the above exsiccatum but failed to publish a description for it. The name is therefore a hyponym. The host was said to be *Phlox Nuttallii* and the specimen was collected by Harkness in California in 1884. There is in the herbarium at Albany a specimen which is undoubtedly a portion of this collection. The host is *Phlox longifolia* Nutt. and the rust is *Allodus Giliae.* Owing to the advanced stage of the rust when collected the plumbeous character is less evident than usual, a fact which no doubt led Ellis to assign a varietal name to this specimen.

Aecidium Wilcoxianum Thüm. Myc. Univ. *2226.* 1884

Under this name a collection made at Boise City, Idaho, April, 1881, by Dr. J. Wilcox, was issued by Thümen without description. It was said to be upon *Phlox Douglasii* but the specimens in the Arthur Herbarium are too fragmentary for host determination. The rust appears to be identical with *Aecidium Giliae* Peck. What appears to be a portion of the same collection was issued under the same name in Roumeguere Fungi selecti exsiccati *5213.* Being issued without description in both cases the name is to be cited as a hyponym.

Aecidium Cerastii Winter; Winter & Demetrio, Hedwigia **24**: 179. 1885

This species was described in an article by Winter and Demetrio entitled "Beitrage zur Pilzflora von Missouri," which appeared in "Heft V" (September and October). In the Jour. Myc. **1**: 126. 1885, No. 10 (October), an article by Dr. Winter appeared under the title "Fungi Novi Missourienses" in which he describes *Aecidium Cerastii* Winter nov. spec. with the identical Latin description used in Hedwigia. What evidence there is seems to indicate that the Hedwigia article appeared first and is therefore to be given preference in citation. The type was described as on living leaves of *Cerastium nutans* Raf. May, 1885. No. *559*. A collection which is a portion of the type bears a label with this further information "near Joh. Hof's residence, Perry Co., Mo.," collected by C. H. Demetrio. A careful examination of the type which is in the possession of Rev. Demetrio shows that the host is probably *Phlox divaricata* and the rust certainly *Allodus Giliae* comparing exactly with similar material on *P. divaricata* from Iowa.

Aecidium Phlogis Peck; Arth. Bull. Iowa Agr. Coll. **1884**: 167. 1885

This name was used by Arthur in a "Preliminary List of Iowa Uredineae" to designate a collection on *Phlox divaricata* var. *Laphamii* Willd. collected at Decorah, Iowa, June 8, 1882, by E. W. D. Holway. On careful examination of this specimen a few telia were found and the rust is *Allodus Giliae* without doubt. The collection on *Phlox pilosa,* Ames, cited under the same name has not been seen and its identity is unknown. No description accompanies the name and it is therefore a hyponym.

Puccinia patagonica Speg. Bol. Acad. Nac. Ci. Argent. **11**: 29. 1887

Spegazzini described this species from collections made at Rio S. Cruz and Rio Gallego, January and August, 1882, on a common *Collomia.* The host species however was not named.

The type collection of this rust has not been seen but the description fits *Allodus Giliae* very closely. Dr. W. G. Farlow sent the writer a specimen from the Farlow collection labelled "Sydow Uredineen *35*a. *Puccinia plumbaria* Peck in foliis calcibusque *Collomiae* sp. Ad Mont. ignion. Colloqui. 1. 1896." This was collected by Neger in Chili. The specimen bears telia only which are apparently identical with those of *Allodus Giliae.* This indicates that *A. Giliae* occurs in South America and substantiates the view that Spegazzini's species is probably identical with *A. Giliae* and should be entered in the synonymy of this species.

The observation of Spegazzini that *P. patagonica* differs wholly from *Puccinia Giliae* Farl. is quite correct. We interpret this reference to *P. Giliae* Farl. as an error for *P. Giliae* Ellis & Hark. which is discussed later in this paper.

Puccinia fragilis Tracy & Gall. Jour. Myc. **4**: 20. 1888

The type collection was described as on *Arenaria pungens* collected at Reno, Nevada, June 19, 1887. Holway[4] has called attention to the host plant which he says is *Phlox*. In the Arthur Herbarium there are three packets purporting to be portions of the type collection. One was taken from the collection of S. M. Tracy, July 5, 1900, and bears the data above and the collectors names, Tracy & Evans. Another specimen marked "type" was received from a collection in the Iowa Agr. College in October, 1898, and bears the same inscription except that Evans's name does not appear on the packet as co-collector. The third packet came from the Holway Herbarium and bears the number *4591*, otherwise the inscription is like that on the first mentioned packet. Examination of the material shows only telia. The host is probably *Phlox longifolia* Nutt. and the rust is certainly *Allodus Giliae.*

Aecidium Phlogis Ellis & Ev. Bull. Torr. Club. **24**: 284. 1897

This species was described from a collection on *Phlox longifolia,* made near Lewistown, Idaho, April, 1896, by A. A. Heller (No. 2992). Ellis and Everhart published the following note with the description: "This is not improbably the *Aecidium* of *Puccinia plumbaria* Peck which is found on the same host." What is apparently a portion of the type collection was issued by Ellis & Ev. in N. Am. Fungi *3582* and is most certainly the aecial stage of *Allodus Giliae* although I have seen no specimens of this collection bearing telia on the same plant.

Puccinia Purpusii P. Henn. Hedwigia **37**: 270. 1898

Hennings described this species from a collection made by Mr. C. A. Purpus in California. The original description included both aecia and telia and purports to have been collected at Potter

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[4] Holway, E. W. D. (loc. cit.).

Valley, Mendocino Co., California, on *Arabis spec.* Holway (1) was apparently the first to call attention to the fact that the rust was *Puccinia plumbaria* and the host some species of *Phlox* or a closely related genus.

The type collection has been examined through the kindness of Dr. P. Sydow, who loaned all the material with the original label to Dr. Arthur for study. The label reads as follows: ("Uredo?) No. 3. on Cruciferae? spec. Potter Valley, Mendocino Co., Calif. A. P. 94." This is in the handwriting of Mr. Purpus, who has recently confirmed it from a photograph of the label sent him by the writer. After the figure "3" the name *Purpusii* is written, but by a different hand, very probably Dr. Hennings. This is undoubted type material and consists of several fragmentary stems and leaves of some plant closely resembling *Microsteris gracilis.* Most of the leaves bear the aecial stage, but one leaf is well covered with telia of the plumbeous sort. The rust is without doubt *Allodus Giliae.*

Puccinia giliicola P. Henn. Hedwigia **37**: 270. 1898; Rab.-Paz. Fungi Eur. *4221.* 1901

Much confusion has existed concerning the exact identity of this species. Hennings published it under the name *P. Giliae* Ellis & Hark. The type being collected on *Gilia californica* at Snow Mt., Coast Range, California, about 7,000 ft. Aug.–Sept., 1894 (A. Purpus). What is undoubtedly the same rust and host and probably a portion of the same collection has been issued under Rabenhorst-Pazschke, Fungi Europaei et extraeuropaei *4221,* and Sydow, Uredineen *1212* but the locality in both of these exsiccati numbers reads, Potter Valley, Mendozo (Mendoc in Sydow Ured. *1212*) Co., Calif., instead of Snow Mountain, Coast Range. Whether there was another collection I have not been able to determine but authentic type material kindly loaned by Dr. P. Sydow with the original penciled label written on American paper reads "Pilz on *Gilia?* Spec. . . . Snow-Mt. Coast-Range—Aug.–Sept. 7500–8000 ft." This label was photographed and sent to Mr. C. A. Purpus, Vera Cruz, Mexico, who writes as follows: "The label enclosed in your letter was written by me.

The fungus was collected on a Gilia spec. growing on rocks at an alt. of 7–8000 ft. on Snow Mt., in the Coast Range of Lake County in northern California. Snow Mountain is one of the highest elevations in the Coast Range as far as I know." Prof. T. S. Brandegee writes that "Snow Mountain is a well known high mountain situated at the corner of Lake and Mendicino Counties, California." It seems probable therefore that in some way the locality for the type collection of *P. giliicola* was confused by Hennings with that of *P. Purpusii* which would account for the discrepancy in localities on the different packets. The specimens in all the packets considered here are identical.

The host of *P. giliicola* is an acerose leaved plant, small and apparently well adapted for dry climates. The rust is in the advanced telial stage only and the sori are not noticeably plumbeous. The spores average a little narrower than those of *Allodus Giliae* being 15–21 × 32–45 μ and are practically smooth. In this respect it compares favorably with collections on *Leptodactylon Nuttallii, Microsteria gracilis* and *Linanthus ciliatus*. Many taxonomists would consider this a distinct species but I believe it to be only a depauperate form of *A. Giliae*. The "uredospores" mentioned by Hennings in the published description are apparently mesospores or single cells of broken teliospores as no urediniospores have been found after several careful examinations.

Aecidium patagonicum Speg. Anal. Mus. Nac. Buen. Aires 3^a. 1: 66. 1902

Spegazzini described this Aecidium on living leaves of *Collomia gracilis* collected near Carren-leofú, in the summer of 1900 (N. Illin.). He says this *Aecidium* appears with *Puccinia Patagonica* and it is probable that the two stages belong together. The type of *A. patagonicum* has not been seen but Spegazzini gives the measurements of aeciospores as 14–16 μ which compare closely with those of *Aecidium Giliae* Peck.

Following is a list of synonymy and host plants of

ALLODUS GILIAE (Peck) Orton, Mem. N. Y. Bot. Gard. **6**: 199. 1916

Aecidium Giliae Peck, Bot. Gaz. **4**: 230. 1879.

Puccinia plumbaria Peck, Bot. Gaz. **6**: 228. 1881.

Puccinia Wilcoxiana Thüm. Myc. Univ. *2032*. 1881.

Puccinia plumbaria phlogina Ellis, N. Am. Fungi *1044*. 1883 hyponym.

Aecidium Wilcoxianum Thüm. Myc. Univ. *2226*. 1884 hyponym.

Aecidium Cerastii Wint.; Winter & Demetrio, Hedwigia **24**: 179. 1885; Jour. Myc. **1**: 125. 1885.

Aecidium Phlogis Peck: Arth. Bull. Iowa Agr. Coll. **1884**; 167. 1885 hyponym.

Puccinia patagonica Speg. Bul. Acad. Nac. Ci. Argent. **11**: 29. 1887.

Puccinia fragilis Tracy & Gall. Jour. Myc. **4**: 20. 1888.

Aecidium Phlogis Ellis & Ev. Bull. Torr. Club **24**: 284. 1897.

Puccinia Purpusii P. Henn. Hedwigia **37**: 270. 1898.

Puccinia giliicola P. Henn. Hedwigia **37**: 270. 1898; Rab.-Paz. Fungi Eur. *4221*. 1901.

Dicaeoma fragile Kuntze, Rev. Gen. **33**: 468. 1898.

Dicaeoma plumbarium Kuntze, Rev. Gen. **33**: 470. 1898.

Aecidium patagonicum Speg. Anal. Mus. Nac. Buen. Aires. 3^{a}. **1**: 66. 1902.

Allodus plumbaria Arth. Result. Sci. Congr. Bot. Vienne 345. 1906.

ON POLEMONIACEAE

Leptodactylon californica H. & A. (*Gilia californica* Benth.) California.

Leptodactylon Nuttallii (A. Gray) Rydb. (*Gilia Nuttallii* A. Gray.) Colorado, Nevada, Utah.

Linanthus ciliatus (Benth.) Greene. (*Gilia ciliata* Benth.) California.

Microsteris gracilis (Dougl.) Greene. (*Collomia gracilis* Dougl. Gilia gracilis Hook.) California, Montana, Oregon, Utah, Washington.

Microsteris humilis Greene, Idaho, Utah.

Microsteris micrantha (Kellogg) Greene. (*Collomia micrantha* Kellogg.) Colorado, Montana, Utah.
Phlox divaricata L. Illinois, Iowa, Missouri.
Phlox longifolia Nutt. California, Colorado, Idaho, Nevada, Utah.
Phlox multiflora A. Nels. Colorado.
Phlox speciosa Pursh. Oregon.
Phlox Stansburgii (Torr.) Heller. Nevada.

2. ALLODUS DOUGLASII (Ellis & Ev.) Orton

Puccinia Douglasii Ellis & Ev. Proc. Acad. Phil. **1893**: 152. 1893

The species was described on *Phlox Douglasii* collected at Detroit, Utah, May 26, 1891, by Marcus E. Jones. The rust differs quite markedly from *Puccinia plumbaria* in that the telia arise from a diffused mycelium usually in linear series on each side of the midrib and the sori are very early naked and prominently pulvinate. The spores are much thickened above with smooth walls and concolorous persistent pedicels. The aecial stage differs in no pronounced way from the aecial stage of *P. plumbaria* and it is extremely difficult to decide where certain aecial collections belong. *Puccinia Douglasii* however seems to constantly inhabit acerose or narrow leaved species of *Phlox* and the aecia do not change the form of the leaf so pronouncedly as do the aecia of *P. plumbaria*. A portion of the type material was submitted to Mr. Standley, who identifies the host as *Phlox diffusa*. *Puccinia Douglasii* therefore is not at present known to inhabit *Phlox Douglasii*.

Puccinia Richardsonii Sydow, Monog. Ured. **1**: 317. 1902

The Sydows described this species from material collected at Helena, Montana, May, 1896, on *Phlox Richardsonii* by F. D. Kelsey, and issued by Ellis and Everhart in N. Am. Fungi *2991* under the name *Puccinia Douglasii*. The host is apparently *Phlox diapensioides* Rydb. and the rust differs in no essential character from *P. Douglasii* on *Phlox diffusa* except that the spores average a little longer.

Following is a list of the synonymy and hosts of

ALLODUS DOUGLASII (Ellis & Ev.) Orton, Mem. N. Y. Bot. Gard. **6**: 198. 1916

Puccinia Douglasii Ellis & Ev. Proc. Acad. Phila. **1893**: 152. 1893.
Dicaeoma Douglasii Kuntze, Rev. Gen. **33**: 468. 1898.
Puccinia Richardsonii Sydow. Monog. Ured. **1**: 317. 1902.

ON POLEMONIACEAE

Phlox alyssifolia Greene. Montana.
Phlox amoena Sims. (*P. procumbens* A. Gray.) Pennsylvania.
Phlox depressa (A. Nels.) Rydb. Montana.
Phlox diapensioides Rydb. Montana.
Phlox diffusa Benth. Oregon, Utah, Washington.
Phlox glabrata (E. Nels.) A. Brand. Wyoming.
Phlox Hoodii Richards. Montana, Utah.
Phlox nana Nutt. New Mexico.
Phlox rigida Benth. Utah.
Phlox scleranthifolia Rydb. Nebraska.
Phlox subulata L. New Jersey.

3. OTHER OUTSTANDING SPECIES

Aecidium Polemonii Peck, Bot. Gaz. **4**: 230. 1879

This *Aecidium* which has been shown by Arthur[5] to be the aecial stage of *Uromyces acuminatus* was first described on *Polemonium reptans* from Iowa. It is now known that the same rust goes to species of *Collomia* and *Phlox* as well as to *Gilia* in all probability. This *Aecidium* is to be distinguished from the *Aecidium* of *Allodus Giliae* by its larger aeciospores which are $15–24 \times 18–27\,\mu$ as contrasted with $13–19 \times 14–22\,\mu$, the size of aeciospores of *A. Giliae*. The walls of the peridial cells also appear to be regularly thicker in *A. Giliae* than in *Nigredo Polemonii*.

Puccinia Giliae Hark. Bull. Calif. Acad. Sci. **1**: 34. 1884

Harkness[6] described this rust which is usually ascribed to

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[5] Arthur, J. C. Cultures of Uredineae in 1910. MYCOLOGIA **4**: 29. 1912.

[6] Harkness. New Species of California Fungi. Bull. Calif. Acad. Sci. **1**: 29–47. 1884.

Ellis & Harkness[7] whose combined paper appeared immediately preceding that of Harkness. The type was collected on leaves and subtending bracts of *Gilia ciliata.* Mt. Diablo, May. *2996.*

There appears to be no specimen in the Ellis collection and it seems probable that Harkness did not send Ellis any of this material. Prof. W. C. Blasdale has kindly visited the Herbarium of the California Academy and found one specimen which he takes to be the type. He says in his letter to Prof. H. S. Jackson (June 8, 1916): "The specimen consists of a single head of *Gilia ciliata* evidently collected after the plant had dried up." The packet bore the following data: *Puccinia Giliae* Hk. Gilia, dead stems, Antioch, June 17, 1882, *2996.* In commenting upon the discrepancy between this data and the published account Prof. Blasdale states further "although the published description gives Mt. Diablo as the type locality I think this specimen represents the type collection as Antioch is near the base of Mt. Diablo and Harkness was decidedly inaccurate in his data relating to his collections. The specimen bears a half dozen sori on the floral bracts."

My examination of a portion of this material sent by Prof. Blasdale shows smooth spores much thickened above (7–13 μ) and measuring 18–28 $\times$ 40–60 μ with pedicel up to 100 μ, rather persistent. It has been impossible to make a careful search for urediniospores with the limited material at hand, but in the one mount made a few appeared which seemed to correspond in every way with the rust which appears on several species of *Gilia* in California and adjacent states which when collected early bears abundant uredinia. The presence of urediniospores and the smooth teliospores conspicuously thickened at the apex makes this rust distinct from any others known on these hosts. It is known at present only from the Rocky Mountain region and the Pacific Coast.

Puccinia arabicola Ellis & Ev. Jour. Myc. 6: 119. 1891

The type of this rust collected by Dr. Macoun and described as forming aecia and telia on *Arabis* sp., Ottawa, Canada, is in the Ellis Herbarium at the New York Botanical Garden. It consists of a single, long-petioled orbicular leaf with six groups of aecia and about ten telia scattered over the under leaf surface. Holway reported that this rust varied in no way from the eastern specimens of *Puccinia plumbaria* Peck on *Phlox divaricata* and that the host was probably some species of *Phlox*. At the time of publishing my *Allodus* paper I had not examined carefully the aeciospores and peridial cells of the species. I have now critically studied it and believe it to be distinct from *Puccinia plumbaria* and I think the host must certainly be some cruciferous plant probably *Cardamine Douglasii* (Lam.) Britton as suggested by Dr. N. L. Britton, who has carefully examined and compared the type collection with phanerogamic collections. The aeciospores are considerably larger than those of *Puccinia plumbaria*.

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[7] Ellis, J. B., and Harkness. New Californian Fungi. Bull. Calif. Acad. Sci. 1: 26–29. 1884.

STATE COLLEGE, PA.